FITZGIBBONS BOILERS

Manufactured Exclusively by

FITZGIBBONS BOILER COMPANY

OSWEGO NEW YORK

SEVENTH EDITION

NEW YORK OFFICE 26 CORTLANDT STREET

H. R. NORTHROP NEW YORK

FITZGIBBONS MARINE BOILERS

DESIGNED FOR

STATIONARY STEAM PLANTS

Official Government Endorsement

Extract from the Official Report of a Government Commission of which Rear Admiral Winfield S. Schley, U. S. Navy, was the presiding member, appointed to test a Fitzgibbons Vertical Marine Boiler:

"The Board is of the opinion, therefore, that the Fitzgibbons Boiler is a remarkably quick steam generator, that the time to get up steam is remarkably short, that the evaporative power of the boiler is remarkably high, to say the least, being almost ideal.

"The construction of the boiler is in every respect first-class. The work done in the Fitzgibbons shop is excellent, as was demonstrated by inspection of different boilers under construction. The Board is of the opinion that this boiler fulfills every expectation and would meet the Board's requirements."

MANUFACTURED EXCLUSIVELY

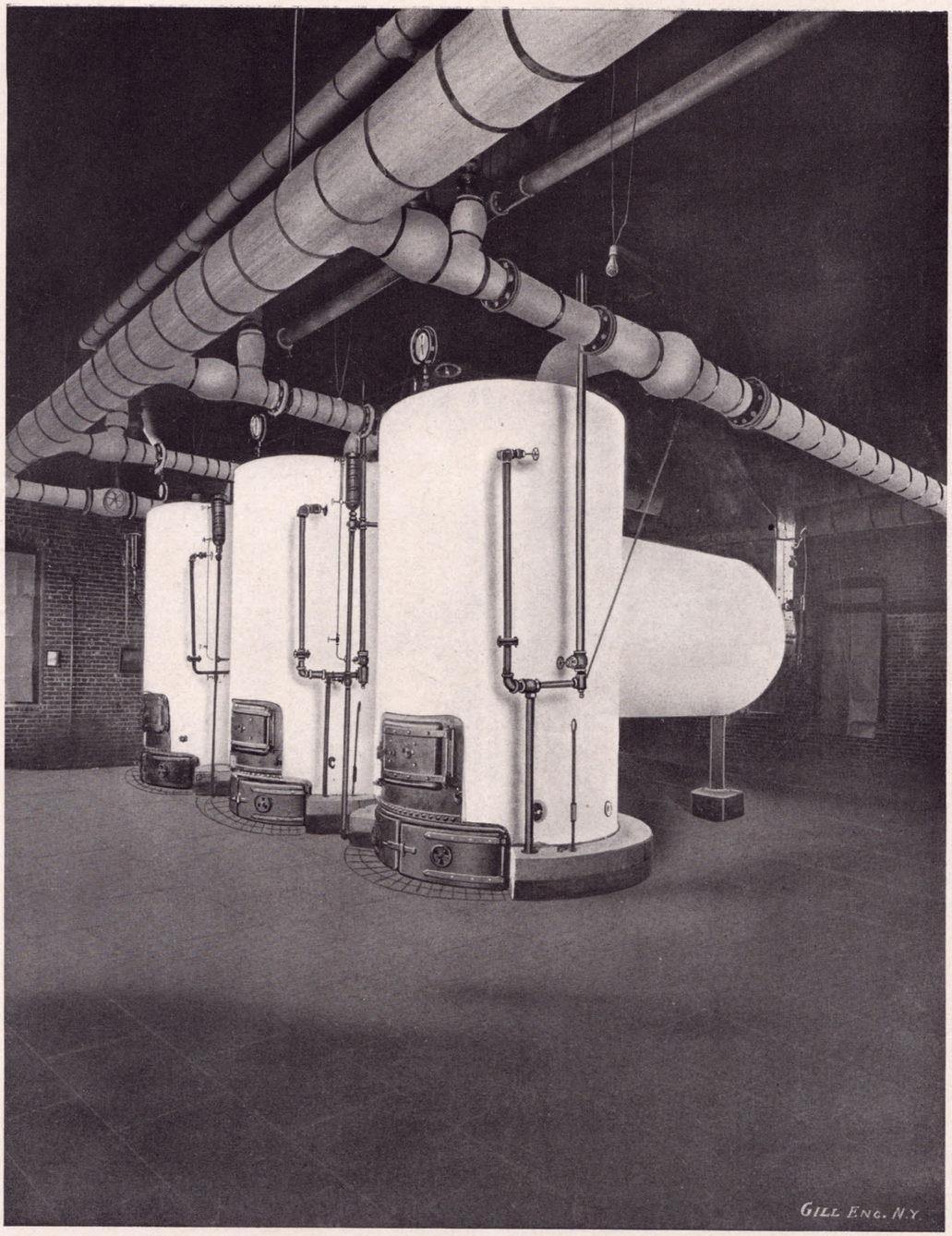
BY THE

FITZGIBBONS BOILER COMPANY

GENERAL OFFICE AND WORKS:

OSWEGO, N. Y., U. S. A.

NEW YORK OFFICE: HAVEMEYER BUILDING, 26 CORTLANDT STREET



A MODERN POWER PLANT OF FITZGIBBONS BOILERS

Designing a Modern Steam Boiler Plant

THE cut on the foregoing page represents a steam plant of Fitzgibbons Vertical Marine Boilers with horizontal submerged tubes from which the greatest possible efficiency may be derived and the cost of maintenance reduced to a minimum, owing to the perfect accessibility provided in the boilers for cleaning and the entire elimination of any form of brick setting.

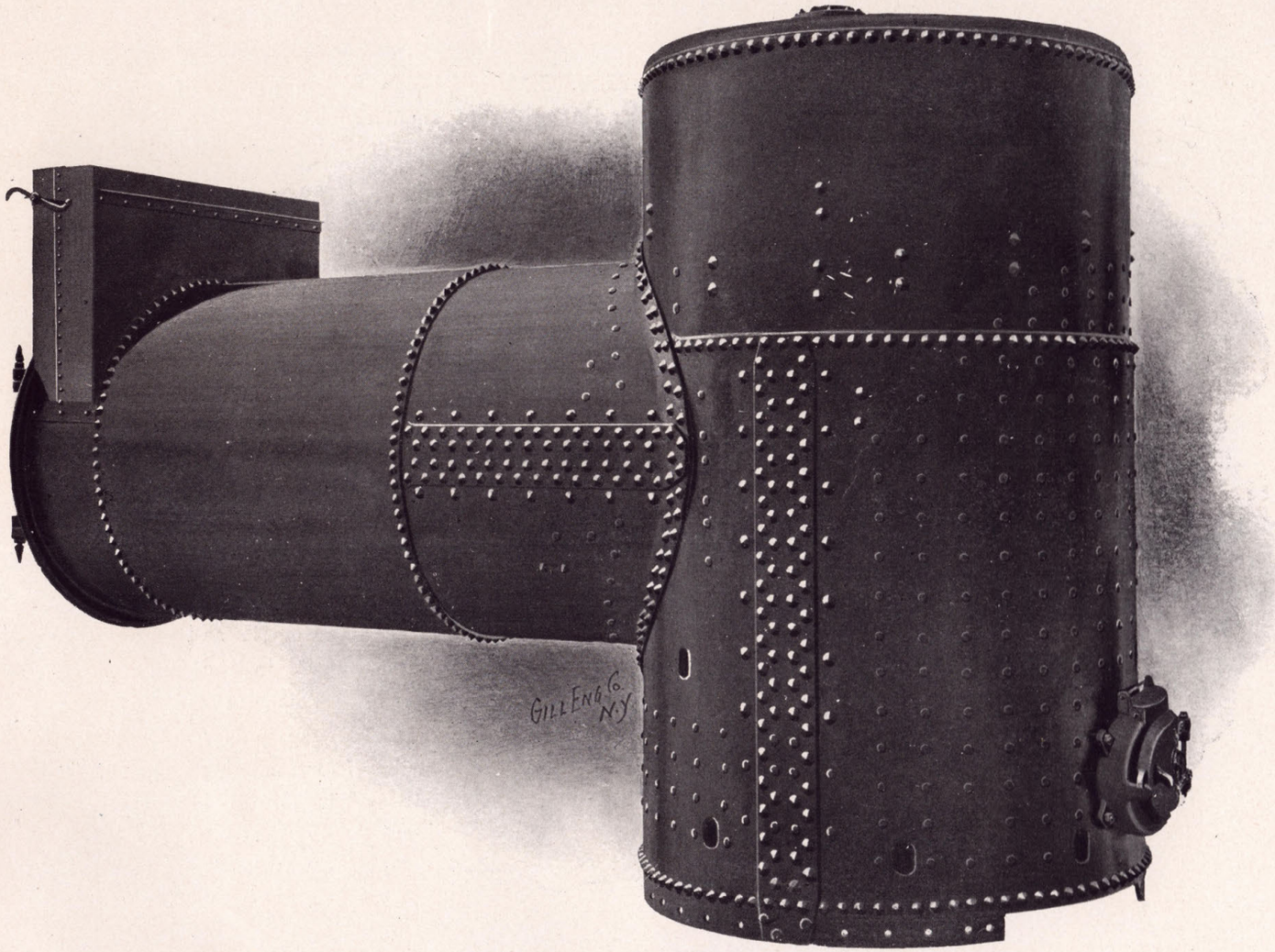
Contrary to the usual fixed conditions in the design of boilers built to conform to standard specifications, the Fitzgibbons design permits a variation in the details of its construction, so that it may be made to conform to the conditions existing in any locality governing the cheapest fuel available, draft, or necessarily restricted boiler room space, and in the operation of any Fitzgibbons boiler plant every economical factor in the production of steam may receive proper consideration. This type of boiler readily adapts itself to different forms of furnaces best suited for various grades of semi-bituminous or anthracite coals, for waste heat gases, sawdust, or refuse in any form. Extension furnaces may be used for either hand firing or mechanical stokers. The different forms of furnaces are illustrated in the pages of this catalogue.

This Company does not make one standard type of Fitzgibbons Boilers to meet all the various conditions existing in different sections of the country, but regards every installation as a problem to be solved through careful consideration of the fuel to be used, the available draft, and all of the requirements of the proposed steam plant, in which we are guided by years of extended experience, as well as exhaustive tests made on boilers of this type in use under different conditions. Fitzgibbons boiler plants, therefore, afford the owners, who accept our plans and specifications, the most efficient and economical steam generation which it is possible to obtain.

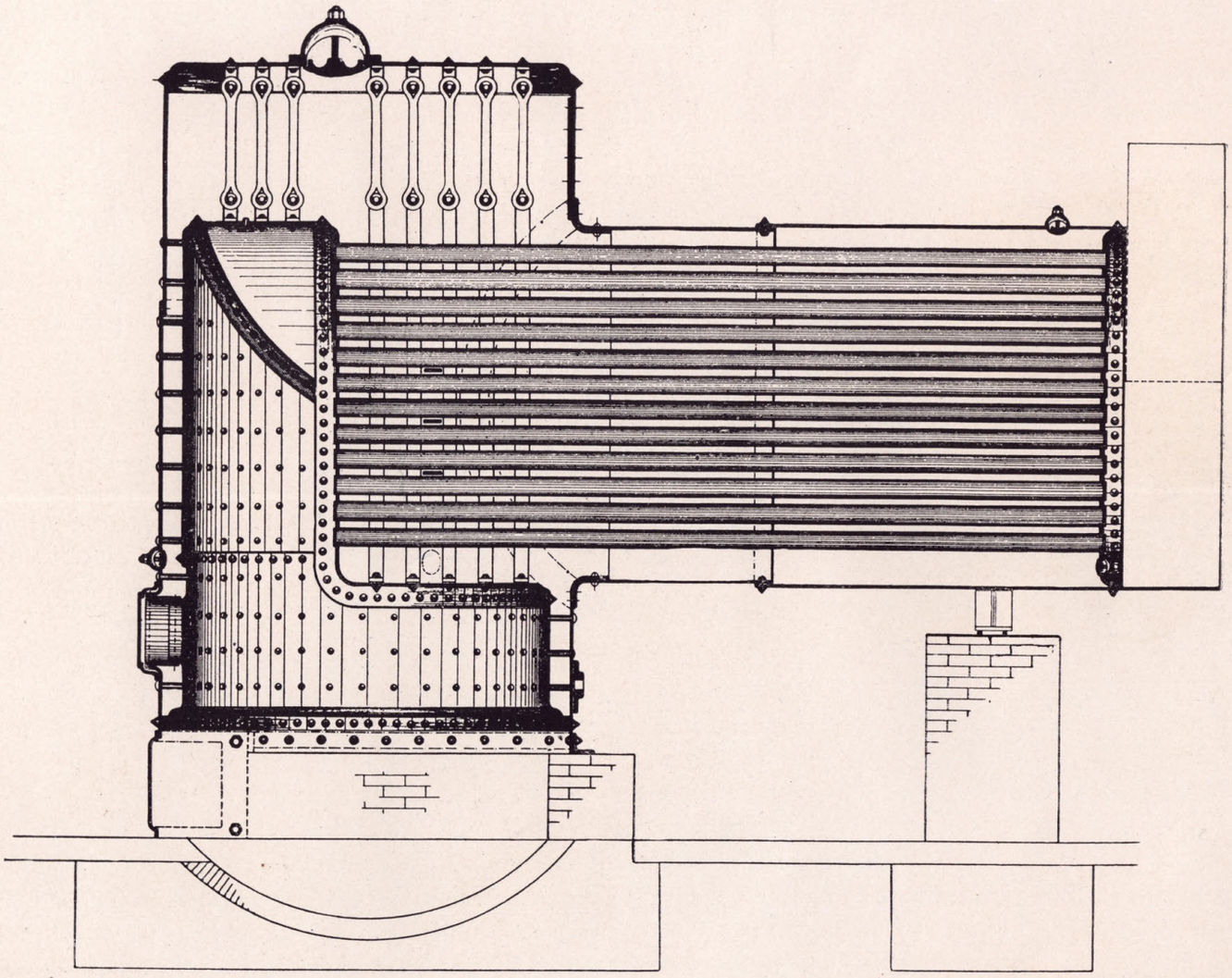
While the Fitzgibbons Boiler permits variations in its design, the special features, making it an unique type of boiler, remain the same in every case. In no other design of boiler has any improvement been made in the furnace to effect more perfect combustion of the gases, with a corresponding increase in efficiency and economy. This can only be effected by the special design of the Fitzgibbons furnace, producing secondary combustion resulting from the proper admixture of air and unconsumed gases in the combustion chamber where the gases are thoroughly consumed before entering the tubes. The perfect combustion in Fitzgibbons Boilers is illustrated on page 9 and this undeniable advantage is proved in the exceptionally high furnace temperature developed.

Exceedingly rapid induced circulation is a marked feature in all Fitzgibbons Boilers, making them the quickest steam generators that have yet been designed.

These marked advantages are more fully explained in the following pages.



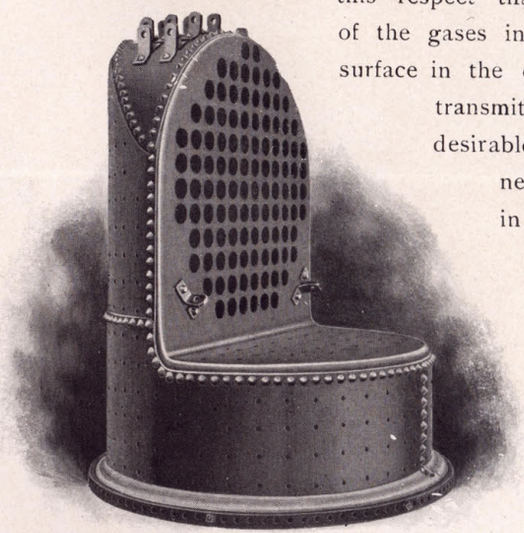
200-HORSEPOWER FITZGIBBONS HEAVY-DUTY VERTICAL MARINE BOILER



SECTIONAL VIEW OF 200-HORSEPOWER FITZGIBBONS HEAVY-DUTY VERTICAL MARINE BOILER

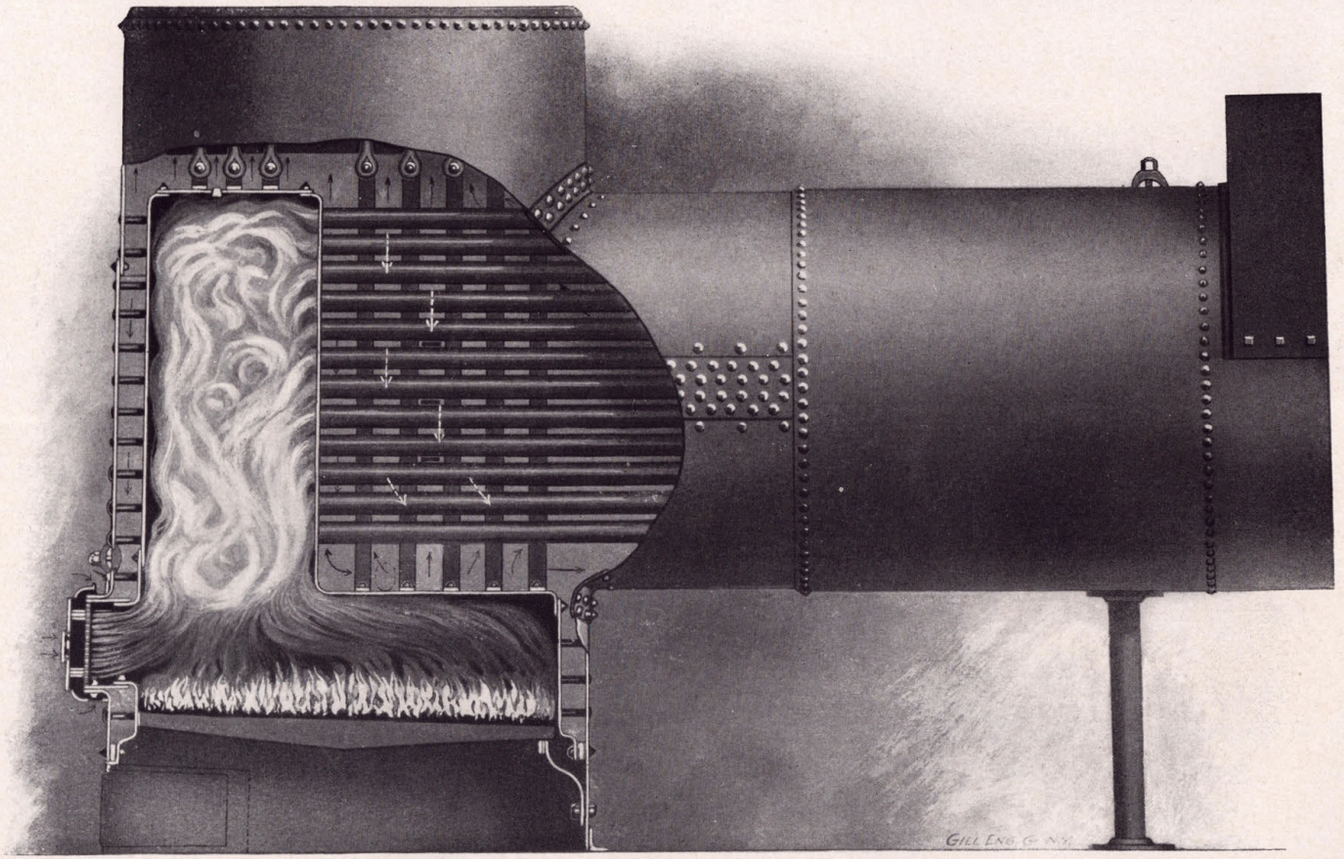
The Design and Construction of Fitzgibbons Vertical Marine Power Boilers

DESIGN — This boiler is a departure from the ordinary types in use, combining the internally fired principle and the economy of floor space of a vertical tubular boiler with the horizontal tubes of the return tubular type, and eliminating at the same time their acknowledged serious defects. Unlike both of these types, and in fact all other types of boilers, the design provides for a large combustion chamber directly over the furnace and in the front or firing end of the boiler. The gases distilled from the coal, and formed in part of carbonic oxide, are brought directly back towards the fire-door, where, at the highest temperature in the furnace, they meet the currents of air introduced through openings provided for the purpose around the door, and complete combustion is effected before the gases enter the fire tubes. The combustion chamber is so efficient in this respect that, with tubes but half the length required in horizontal tubular boilers, the temperature of the gases in the uptake is reduced to the lowest limit consistent with practical efficiency. The heating surface in the combustion chamber is, moreover, carried to within a short distance of the water level and transmits the final increment of heat necessary for the rapid generation of steam in the most desirable part of a steam boiler. The tube barrel is entirely submerged, and the water therein necessarily rising to the highest level, which is in the vertical shell, displaces the water in the leg about the furnace so that an exceedingly rapid circulation is effected in a clearly defined and unchanging path. The boiler being constructed entirely of cylindrical shells offers no restriction to the circulation, so that it has not only the advantage of being a remarkably quick steamer, but furnishing dry steam. This advantage over the types of rapid steaming boilers of water tubulous construction, in which there is always more or less restriction in the circulation, is apparent from the design, since the heating surfaces are not only so arranged as to insure dry steam, but the free circulation prevents the lifting of any water in the process of steam separation at the water line. See cut on page 9.



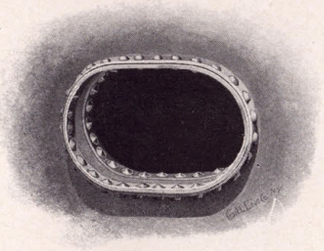
COMBUSTION CHAMBER.

CONSTRUCTION — The tube shell is flanged and riveted to the vertical shell, the opening in which is cross-braced to give it the strength of a complete cylinder. The vertical shell is screw-stayed to the cylindrical furnace and combustion chamber so that the full strength of this complete body is imparted to it. The bracing is shown in sectional cut on page 7. The service of these boilers under all conditions and after years of excessive duty, as well as by careful measurements made while under extreme hydrostatic pressures has demonstrated beyond any doubt that they are equally strong in all of their parts.



ILLUSTRATING PERFECT COMBUSTION AND CIRCULATION IN A FITZGIBBONS VERTICAL MARINE BOILER

The small D crown-sheet shown in cut on preceding page, is the only flat fire surface in the boiler, and it is perfectly accessible from the outside for examination or cleaning by two handholes provided in the side of the vertical shell and on a level with it. The ebullition is so violent, however, not only on the D crown-sheet but on the crown of the combustion chamber, that no scale or sediment will remain on them



FIRE-DOOR OPENING

The fire-door opening is flanged out in all boilers of large size, in order to avoid the thickness of metal formed otherwise by the outside shell, wrought-iron door ring and ogee flange on the furnace sheet. The intense heat of combustion of the carbonic oxide and hydrogen with the oxygen in the air, when they meet in this part of the furnace, necessitates some form of protection, or a water surface such as is provided by the flanged opening shown in the cut. The necessity for such protection is indisputable evidence of the complete combustion which this design of furnace effects. A part of the air used is heated before entering the furnace by passing over the hot shell of the boiler under the door casting, which is bolted to the shell, and is distributed by a perforated plate bolted to the inside of the furnace-door. This furnishes a supply of warm air which may be regulated by a device in the fire-door frame.

SAFETY — Not only is this boiler so designed that the full strength of cylindrical construction is preserved, but the combustion chamber, in addition to its economic merit, affords a crown-sheet directly over the furnace and also above the highest row of tubes, wherein is screwed a fusible plug. The combustion chamber being at the high temperature of the burning gas, the plug is instantly fused in case of low water and before any part of the fire sheets or tubes are exposed with the attendant danger of explosion; the steam finding an outlet through the plug escapes directly upon the body of coal on the grates, checking the fire to such an extent that it is impossible to injure the boiler and provides absolute immunity from explosion from this cause. A record of twelve years has demonstrated the reliability of this device, in which period a boiler of this design has never been injured by low water, although through negligence these plugs have been fused in numerous instances and burned fire-boxes and explosions have been thereby averted.

QUICK STEAMING — There is no type of shell boiler wherein the water spaces are so thoroughly and uniformly cut up with effective heating surfaces — nearly all of them horizontal — as in the Fitzgibbons, with the result that steam is made very rapidly and in less than half the time required in any brick-set externally fired boiler and in less time than in any other type, as was demonstrated in competitive tests made by a Government Board appointed for that purpose, of which Rear Admiral W. S. Schley, U. S. Navy, was the President. This design, with modifications to induce even more rapid steaming, has been used in fog-signal stations, fire engines and for stationary pumping plants for fire purposes.

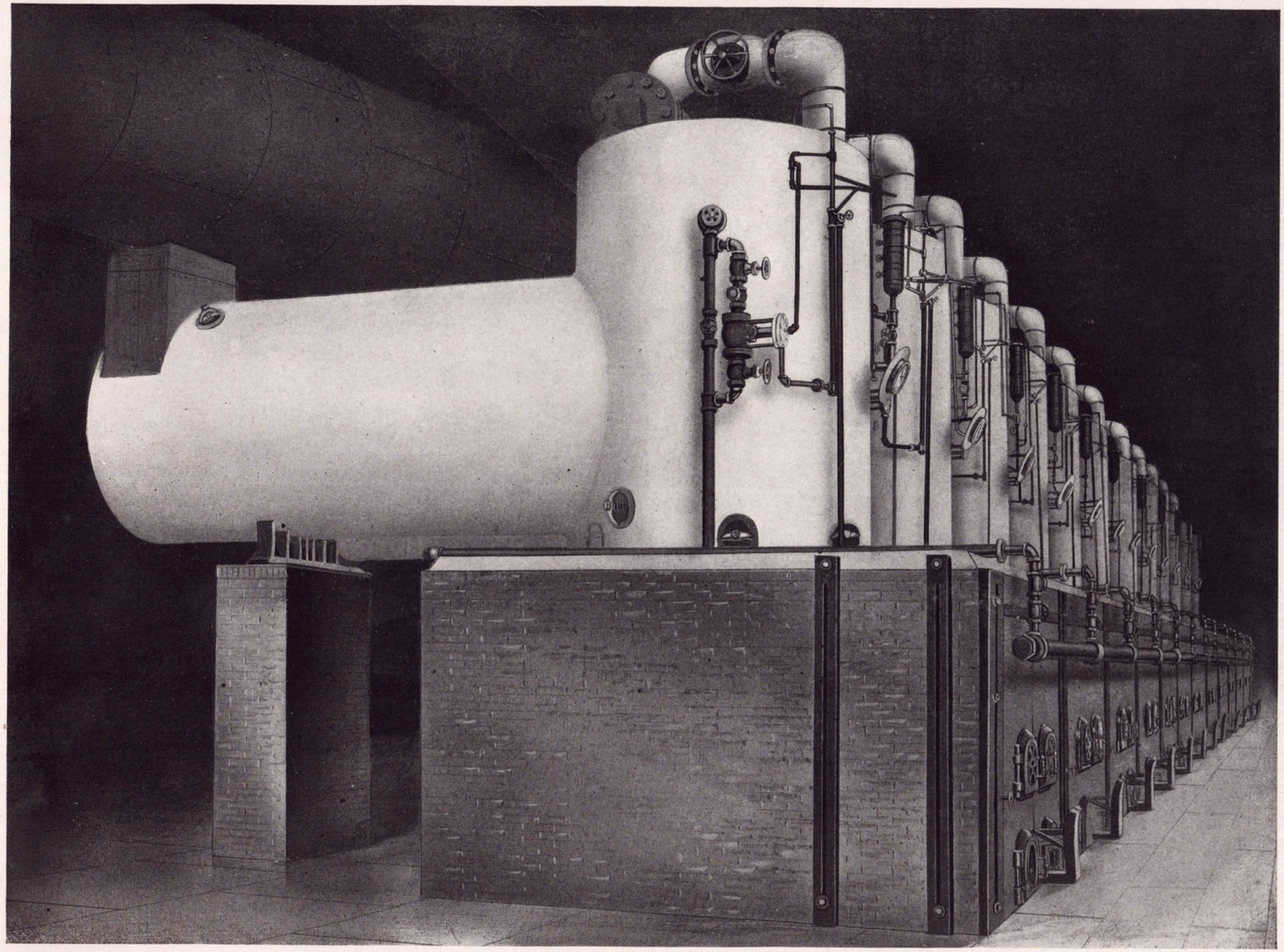
ECONOMY—The economy in fuel is one of the most striking characteristics, not alone from theoretical deductions based upon perfect combustion of the fuel and absorption of all of the available heat units and perfect circulation, but from the result of many comparative tests and the evidence of many users, whose statements unanimously testify to its every-day practical saving in coal under all conditions of service. It has been largely used in several States in public institutions, where its comparative economy with other types of boilers has been so evident that no other boiler was considered in replacements or enlargements to the plants. The Government has installed them where economy and reliability were conditions of paramount importance, owing to the difficulty in supplying coal or the inaccessibility of the plants for making repairs. The most prominent engineers have adopted them in their private practice, and they have established their claim to greater efficiency than any other type of boiler which has yet been designed.

ACCESSIBILITY—This type offers every facility for thorough examination, both externally and internally. A leak about a rivet or seam is at once apparent on the covering used for heat installation, and there is no brick-work to hide defects of this character. The furnace and combustion chamber are open to ready examination. Manholes or handholes make the entire interior visible to the eye and within easy reach. All parts of the water-leg can be reached through handholes around the base of the boiler. A handhole in the tube-head under the tubes affords easy facility for cleaning out the bottom of the tube shell. A manhole may be provided in the tube head if desired in boilers of large size. It is of importance to note in this connection that in a horizontal tubular boiler the deposit of deepest sediment is in the bottom of the cylindrical shell, which is its natural reservoir. This part of the boiler is in closest contact with the fire and such deposits of sediment are very apt to cause burned plates and disastrous explosions. The tube shell in the Fitzgibbons Boiler also collects most of the sediment, but not being in contact with the fire, no injury can possibly result from its accumulation.

MAINTENANCE—The cost of maintenance in Fitzgibbons Boilers is reduced to a minimum. There is no brick-setting requiring annual repairs, not only an expense in itself, but often necessitating shutting down an entire plant to make them, and which is likely to occur at the most inopportune time. These boilers are built with every safeguard in their detailed construction to insure their durability, and during a period of service from one to twelve years in the public institutions of the State of New York, an aggregate of many thousand horse-power have required practically no repairs except from slight leaks which were in every instance caused by acknowledged negligence.

The advantages of this type of boiler are therefore briefly:

1. A marked saving in fuel as compared with brick-set tubular boilers.
2. An economy in floor space of 40 per cent over any horizontal boiler.
3. Less height required than for horizontal tubular boilers.
4. Absolute immunity from explosion from low water.
5. Freedom from any form of brick setting.
6. The best construction possible guaranteed
7. Any desired pressure and in excess of safe pressures carried in horizontal tubular boilers, owing to the fact that it is internally fired.



PLANT OF TWELVE 250–H. P. FITZGIBBONS BOILERS

FITZGIBBONS VERTICAL MARINE POWER BOILERS

WITH HORIZONTAL SUBMERGED TUBES

STANDARD COMPACT DESIGN

HEAVY-DUTY BOILERS — These boilers are built to carry a safe working pressure of 120 pounds to the square inch, or higher if desired and so ordered. In all of the material used, and in their detailed construction, they are made to conform to the highest standards of boiler-making in every particular. They are designed and constructed to endure continuous and severe duty under a high pressure of steam and to meet these conditions with perfect safety and reliability. Flat braces of the best refined iron, the ends of which are doubled over and welded, forming a double thickness before the eyes are formed, with jaws made by doubling over square iron and welding it upon itself, are used exclusively in these boilers, and in number they exceed the factor of safety demanded by the best practice. No. 8 and No. 9 have longitudinal seams on the vertical shells treble-riveted. No. 10 and No. 11 have all longitudinal seams treble-riveted. The longitudinal seams on the vertical shells of No 12 and No. 13 and all longitudinal seams on No. 14 and above are butt-joints, treble-riveted, with double covering strips. This type of boiler may be built to carry safely any desired steam pressure in excess of that called for in the standard boilers.

LIGHT-DUTY BOILERS — These boilers are built to carry a safe working pressure of 100 pounds to the square inch and to meet all of the ordinary commercial demands on a steam boiler. The thickness of plate and the bracing conform to the government rule for 100 pounds steam pressure, and they are so tested, as well as under 150 pounds hydrostatic pressure. The design is the same as in Heavy-Duty Boilers, but the special construction employed for high steam pressures has been eliminated only so far as is consistent with perfect safety. The longitudinal seams are double-riveted instead of being treble-riveted on No. 1 to No. 11, and from No. 12 to No. 14 inclusive treble-riveted lap seams replace the butt-joint and covering-strip construction. For all ordinary purposes this class of Fitzgibbons Boilers may be used as advantageously as those designed for heavy duty and at a considerable reduction in cost.

FITZGIBBONS VERTICAL MARINE POWER BOILERS

WITH HORIZONTAL SUBMERGED TUBES

STANDARD COMPACT HEAVY-DUTY BOILERS

Number of Size	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Horse-Power	**10**	**15**	**20**	**25**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**125**	**150**	**175**	**200**	**225**	**250**
Width over all, inches	31	35	38	40	42	47	51	56	59	61	63	65	69	75	79	83	85	87
Height over all, inches*	82	86	90	91	93	97	104	110	113	120	121	124	130	138*	147*	151*	151*	155*
Length, feet and inches	6-4	7-0	7-6	8-3	9-3	10-5	11-5	11-6	12-8	12-9	13-10	14-8	15-9	16-1	17-1	17-7	18-8½	19-3
Height of Water Line, inches*	66	70	73	76	76	78	85	89	92	98	98	100	106	114	121*	126*	127*	129*
Diameter Smokestack, inches	13	14	20	20	22	22	24	24	26	26	26	27	29	32	34	36	37	38
Height Smokestack, feet†	40	45	50	55	65	65	70	70	70	70	75	80	85	90	100	100	100	100
Steam Opening, inches	2	2	3	3	3½	4	4	4	4	5	5	5	6	6	6	6	6	6
Feed Opening, inches	1½	1½	1½	1½	1½	1½	2	2	2	2	2	2	2	2	2	2	2	2
Safety Valve, Pop, inches	1½	1½	2	2	2	2½	3	3	3	3	3½	3½	4	4	4	4	4	4
Safety Valve, Lever, inches	1½	1½	2	2	2½	3	3½	3½	3½	4	4	4	5	5	5	5	5	5
Thickness Vertical Shell, inches	¼	5/16	5/16	5/16	5/16	36/100	39/100	39/100	41/100	7/16	7/16	4/10	7/16	46/100	½	51/100	52/100	53/100
Thickness Tube Shell, inches	¼	¼	¼	5/16	5/16	5/16	3/8	3/8	3/8	3/8	3/8	39/100	42/100	39/100	7/16	7/16	7/16	45/100
Thickness Furnace, inches	¼	¼	5/16	5/16	5/16	5/16	5/16	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	7/16	7/16	7/16
Thickness Top Heads, inches	5/16	5/16	5/16	5/16	5/16	3/8	39/100	4/10	41/100	7/16	7/16	½	½	½	½	5/8	5/8	5/8

*The heights of boilers and water lines in the above table marked with an asterisk include a circular brick base and ash-pit upon which boilers No. 14 and above are designed to stand, which is 14 inches high for No. 14, and for Nos. 15 to 18 inclusive, 16 inches. See cut, page 4.

†The heights of smokestacks in the above table are proportioned to the draft required to develop under ordinary conditions the full rated horse-power of the boilers burning a fair grade of semi-bituminous coal. Culm or very small sizes of anthracite coal, unless a special furnace is provided, usually require either an induced draft, steam jet or blower in addition to the chimney draft available.

INSURANCE — Certificate of inspection and policy of insurance in any boiler insurance company will be furnished if desired.

FITZGIBBONS VERTICAL MARINE POWER BOILERS

WITH HORIZONTAL SUBMERGED TUBES

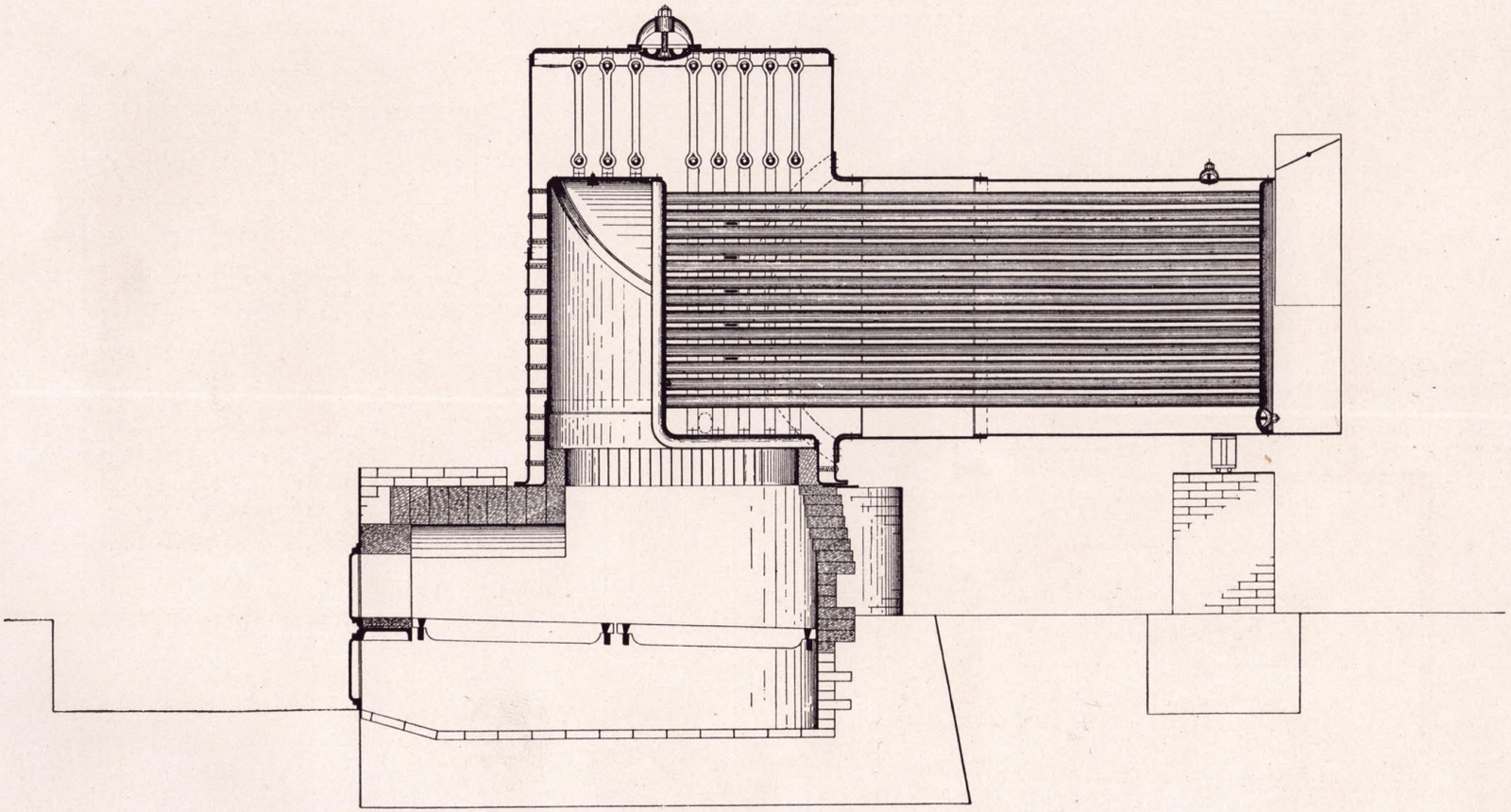
STANDARD COMPACT LIGHT-DUTY BOILERS

Number of Size	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Horse-Power	**10**	**15**	**20**	**25**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**125**	**150**	**175**	**200**	**225**	**250**
Width over all, inches	31	35	38	40	42	47	51	56	59	61	63	65	69	75	79	83	85	87
Height over all, inches*	82	86	90	91	93	97	104	110	113	120	121	124	130	138*	147*	151*	151*	155*
Length, feet and inches	5-7	6-3	7-2	7-10	8-8	9-6	10-5	10-5	11-4	11-7	12-6	13-2	14-0	14-5	15-1	15-7	16-5	17-3
Height of Water Line, inches*	66	70	73	76	76	78	85	89	92	98	98	100	106	114*	121*	126*	127*	129*
Diameter Smokestack, inches	13	14	20	20	22	22	24	24	26	26	26	27	29	32	34	36	37	38
Height Smokestack, feet†	40	45	50	55	65	65	70	80	80	80	85	90	100	100	110	110	110	120
Steam Opening, inches	3	3	3	3	3½	4	4	4	4	5	5	5	6	6	6	6	6	6
Feed Opening, inches	1½	1½	1½	1½	1½	1½	2	2	2	2	2	2	2	2	2	2	2	2
Safety Valve, Pop inches	1½	1½	2	2	2	2½	3	3	3	3	3½	3½	4	4	4	4	4	4
Safety Valve, Lever, inches	1½	1½	2	2	2½	3	3½	3½	3½	4	4	4	5	5	5	5	5	5
Thickness, Vertical Shell, inches	1/4	1/4	1/4	1/4	26/100	5/16	32/100	35/100	3/8	38/100	4/10	38/100	4/10	7/16	4/10	7/16	7/16	45/100
Thickness Tube Shell, inches	1/4	1/4	1/4	5/16	5/16	5/16	5/16	3/8	3/8	3/8	3/8	3/8	3/8	3/8	39/100	7/16	7/16	7/16
Thickness Furnace, inches	1/4	1/4	5/16	5/16	5/16	5/16	5/16	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	7/16	7/16
Thickness Top Head, inches	5/16	5/16	5/16	5/16	5/16	3/8	3/8	3/8	3/8	7/16	7/16	7/16	7/16	1/2	1/2	1/2	1/2	1/2

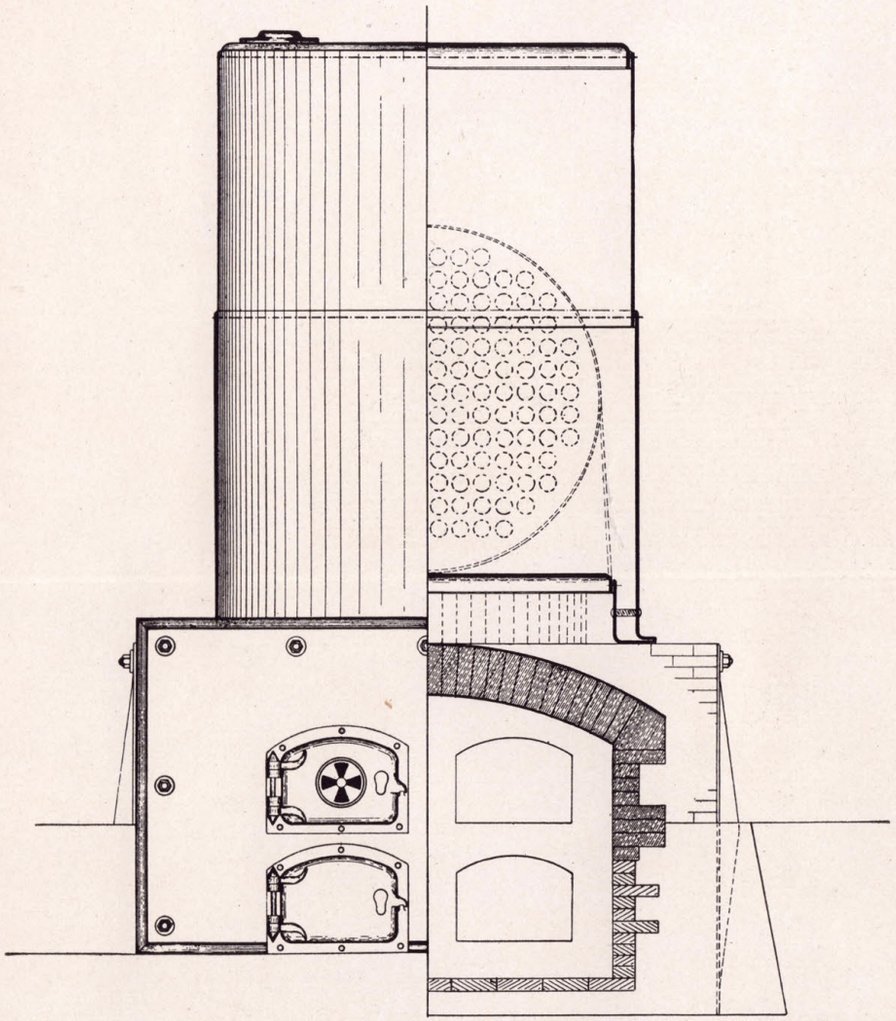
*The heights of boilers and water lines in the above table marked with an asterisk include a circular brick base and ash-pit upon which boilers No. 14 and above are designed to stand, which is 14 inches high for No. 14, and for Nos. 15 to 18 inclusive, 16 inches. See cut, page 4.

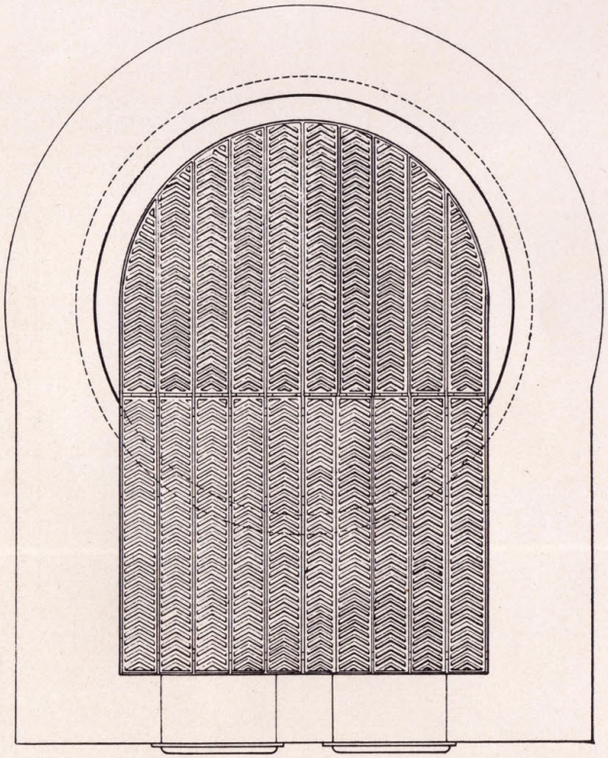
†The heights of smokestacks in the above table are proportioned to the draft required to develop under ordinary conditions the full rated horse-power of the boilers burning a fair grade of semi-bituminous coal. Culm or very small sizes of anthracite coal, unless a special furnace is provided, usually require either an induced draft, steam-jet or blower in addition to the chimney draft available.

INSURANCE — Certificate of inspection and policy of insurance in any boiler insurance company will be furnished if desired.



SECTIONAL VIEW OF 150 HORSE-POWER FITZGIBBONS HEAVY DUTY VERTICAL MARINE BOILER
WITH EXTENSION FURNACE

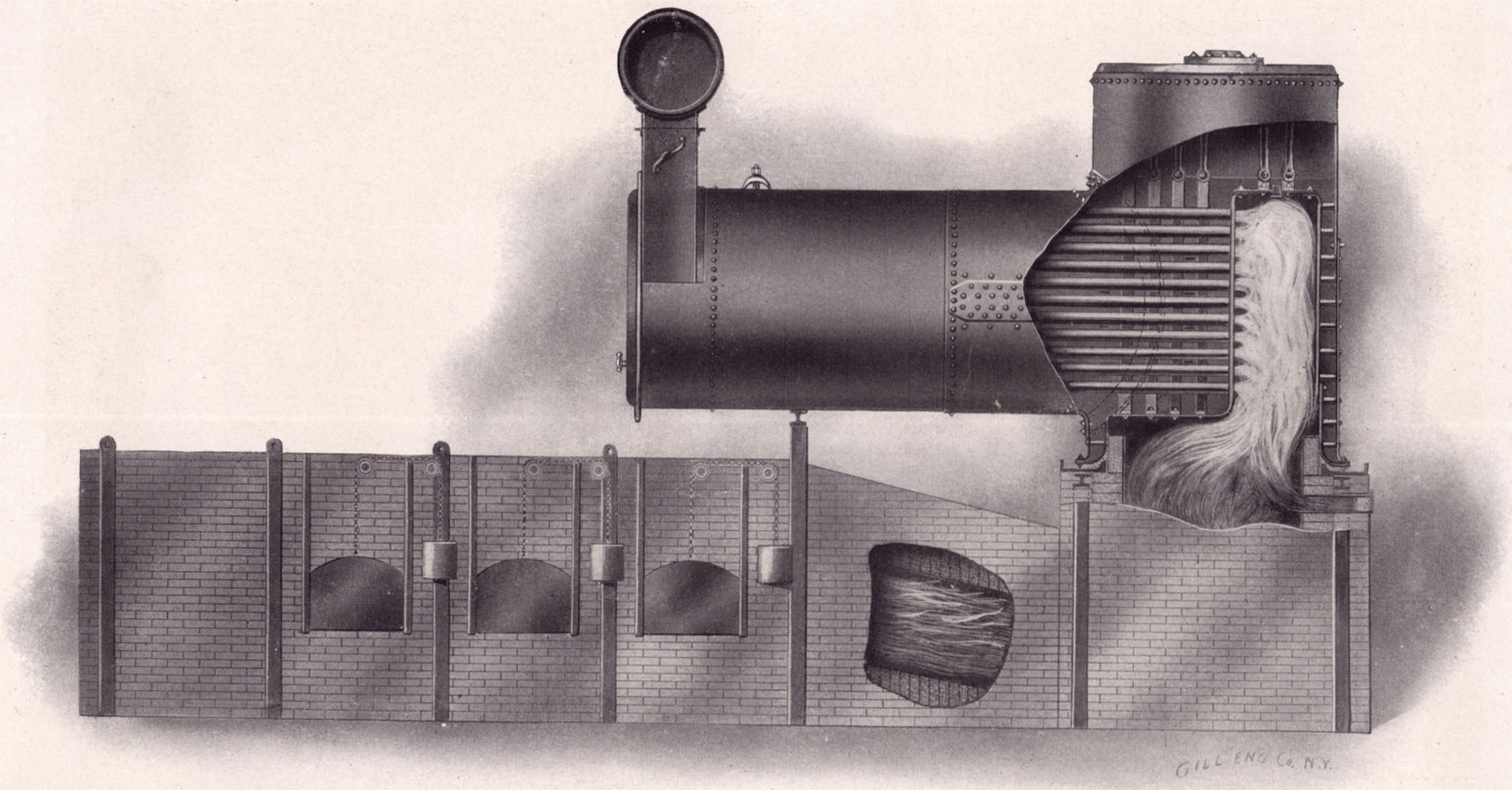




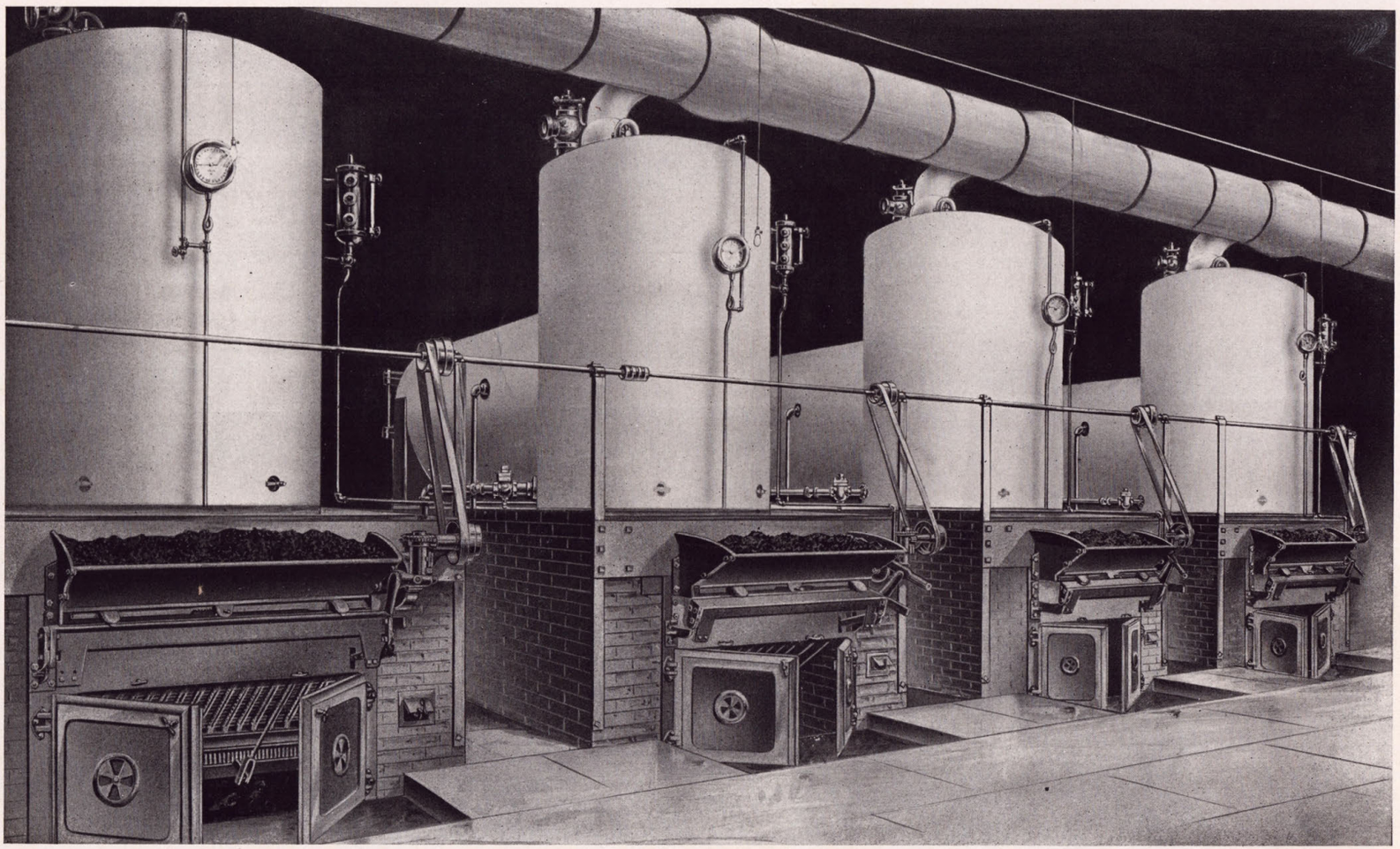
DIMENSIONS

Grate surface,	40 sq. ft.
Length over all,	19 ft. 4 in.
Width over all,	8 ft. 1 in.
Height over all,	11 ft. 6 in.
Height of foundation,	2 ft. 7 in.
Depth of firing pit,	1 ft. 10 in.

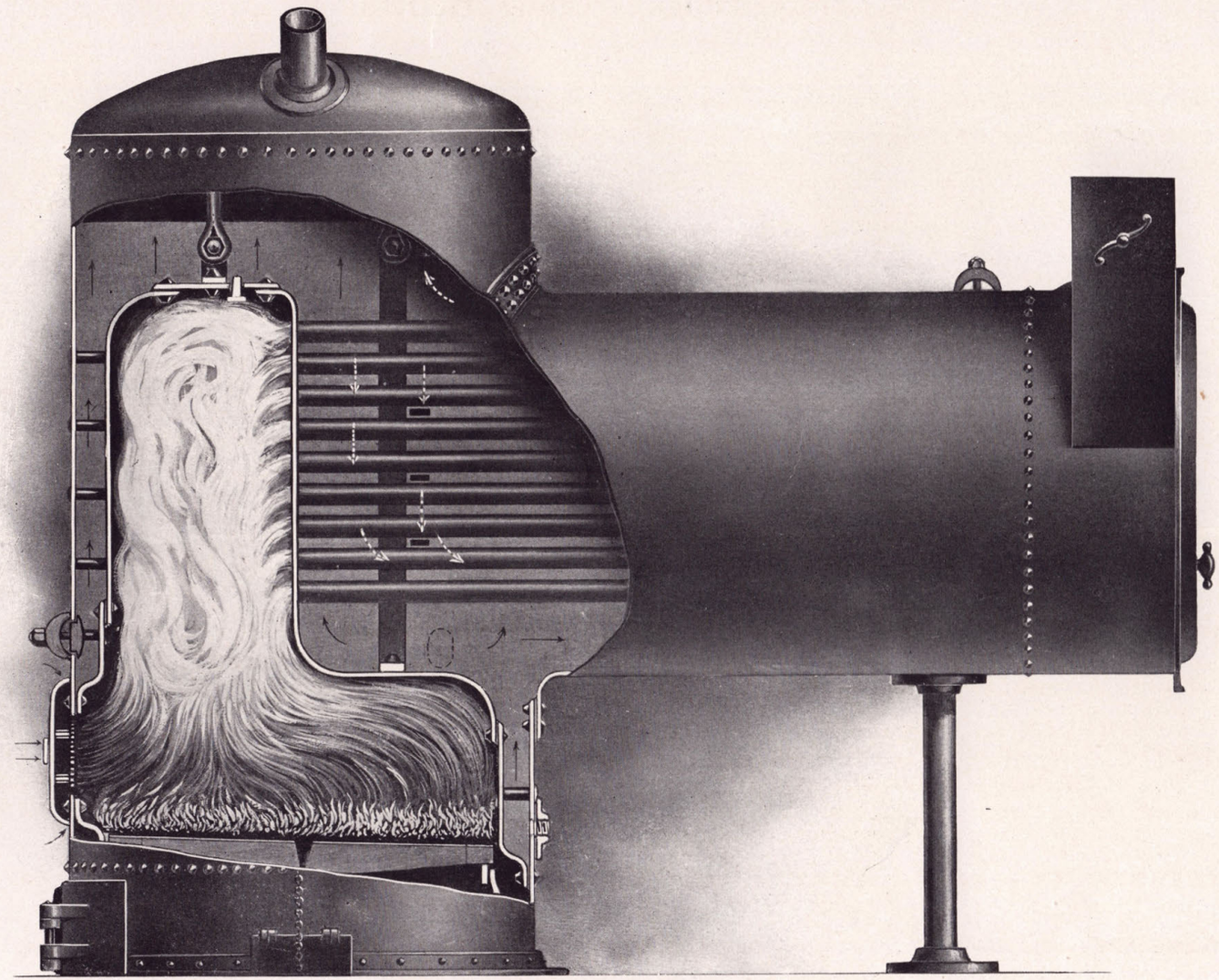
SECTIONAL VIEWS OF 150 HORSE-POWER FITZGIBBONS HEAVY DUTY VERTICAL MARINE BOILER WITH EXTENSION FURNACE



FITZGIBBONS BOILER DESIGNED FOR UTILIZING WASTE HEAT GASES



FITZGIBBONS BOILER PLANT EQUIPPED WITH MECHANICAL STOKERS



FITZGIBBONS BOILER DESIGNED FOR HEATING

Fitzgibbons Heating Boilers

The acknowledged excellence of the Fitzgibbons design of power boiler, as the best internally fired type which has yet been designed, has led to its adaptation for steam and hot water heating and the elimination of expensive details in construction for high pressures brings its cost within the range of horizontal tubular boilers, used in heating plants, over which it possesses the following marked advantages.

ECONOMY IN FUEL — In the illustration on page 20, it will be at once apparent that perfect combustion is affected by bringing the gases distilled from the coal directly back towards the fire door, where the necessary amount of air is admitted to entirely consume the gases in the chamber provided for that purpose. The radiation from brick furnace walls is entirely eliminated. Moreover, at a low rate of combustion a circular grate is much more efficient than a rectangular one, on which there are dead portions when carrying a light fire, which permit cold air to draw through the ashes and thereby checks the steam producing effects of the live portions. In a Fitzgibbons Boiler, the full benefit of the coal burned is obtained and the fire checked or accelerated by the automatic devices much more readily and positively than in boilers having rectangular furnaces. Comparative tests of actual coal consumption have demonstrated a saving of fully one-third.

ECONOMY IN FLOOR SPACE — Fitzgibbons Boilers require less than one-half the floor space of horizontal tubular boilers. As the grates are circular, these boilers may have the fire door located at any place on the circumference of the vertical shell, which permits the most economical combination of boiler and fire room.

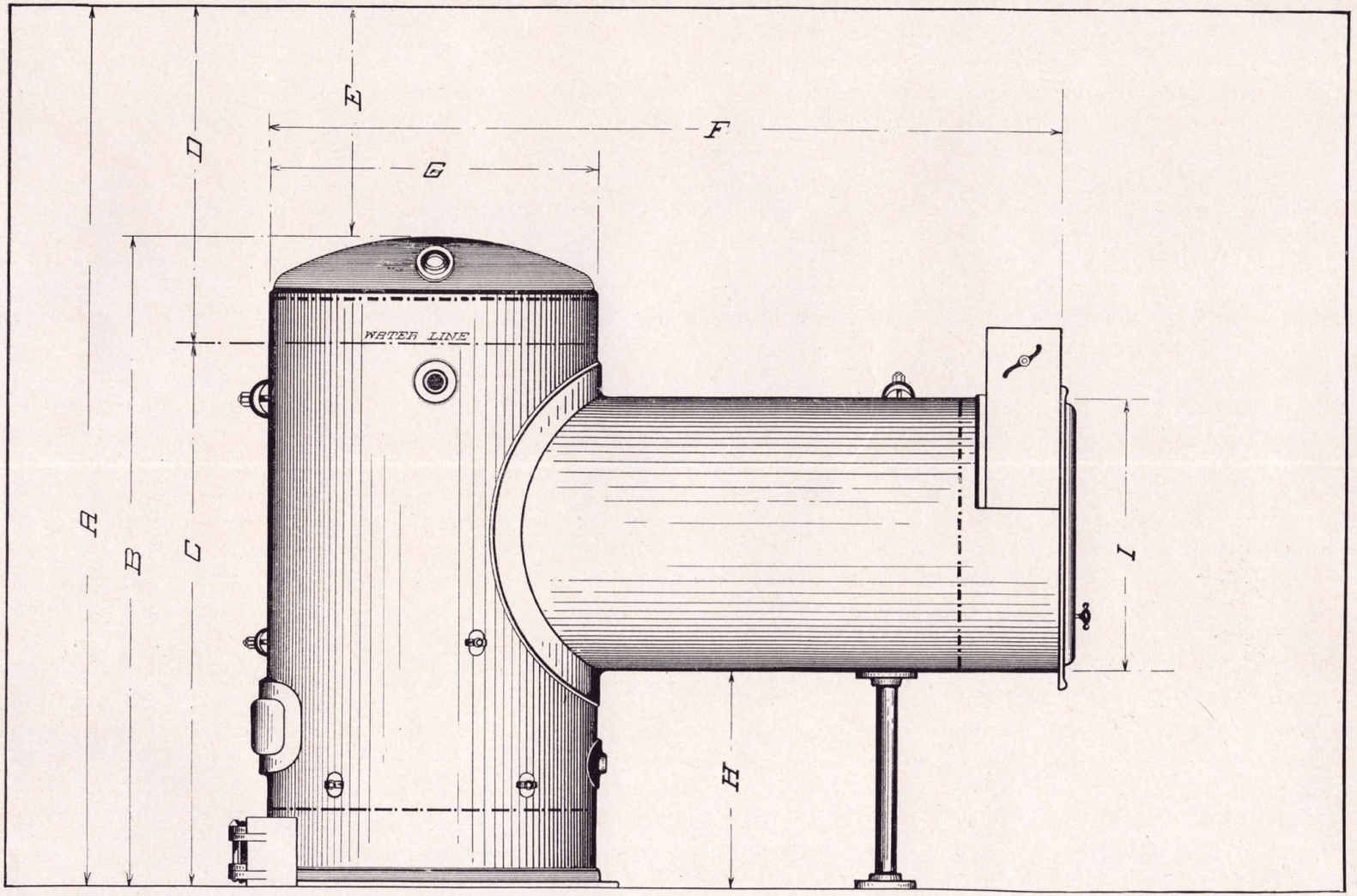
ELIMINATION OF BRICK FURNACES — Freedom from brick furnaces is an advantage at once apparent, not only because the entire heat in the furnace is transmitted to the water in the boiler, but the principal expense of maintaining a brick-set boiler is in relining the furnaces with fire brick, replacing arches and relaying brick walls.

CONSTRUCTION — Conformity with the strictest requirements of the leading boiler insurance companies, state and municipal regulations, insures the highest grade of material and the best workmanship — in all respects equal to that of Fitzgibbons Power Boilers, which are conceded to conform to the highest standards of boiler making demanded by the leading engineers of the country.

SAFETY — A fusible plug provides absolute immunity from possible explosion from low water, for owing to its location in the crown sheet of the combustion chamber, it is fused before any fire surface is exposed with the consequent danger of explosion from low water, and the steam will put out the fire on the grate at once. *Its operation is absolutely certain and the result positive.*

ACCESSIBILITY — Hand-holes provide easy means for cleaning these boilers in every part and the interior may be readily examined from the outside.

PRESSURE — All boilers are tested to 100 pounds hydrostatic pressure and may be safely used for operating pumps, fans or other mechanical auxiliaries of a modern heating plant.



FITZGIBBONS STANDARD COMPACT HEATING BOILER VERTICAL MARINE TYPE WITH HORIZONTAL SUBMERGED TUBES

FITZGIBBONS STANDARD COMPACT HEATING BOILERS

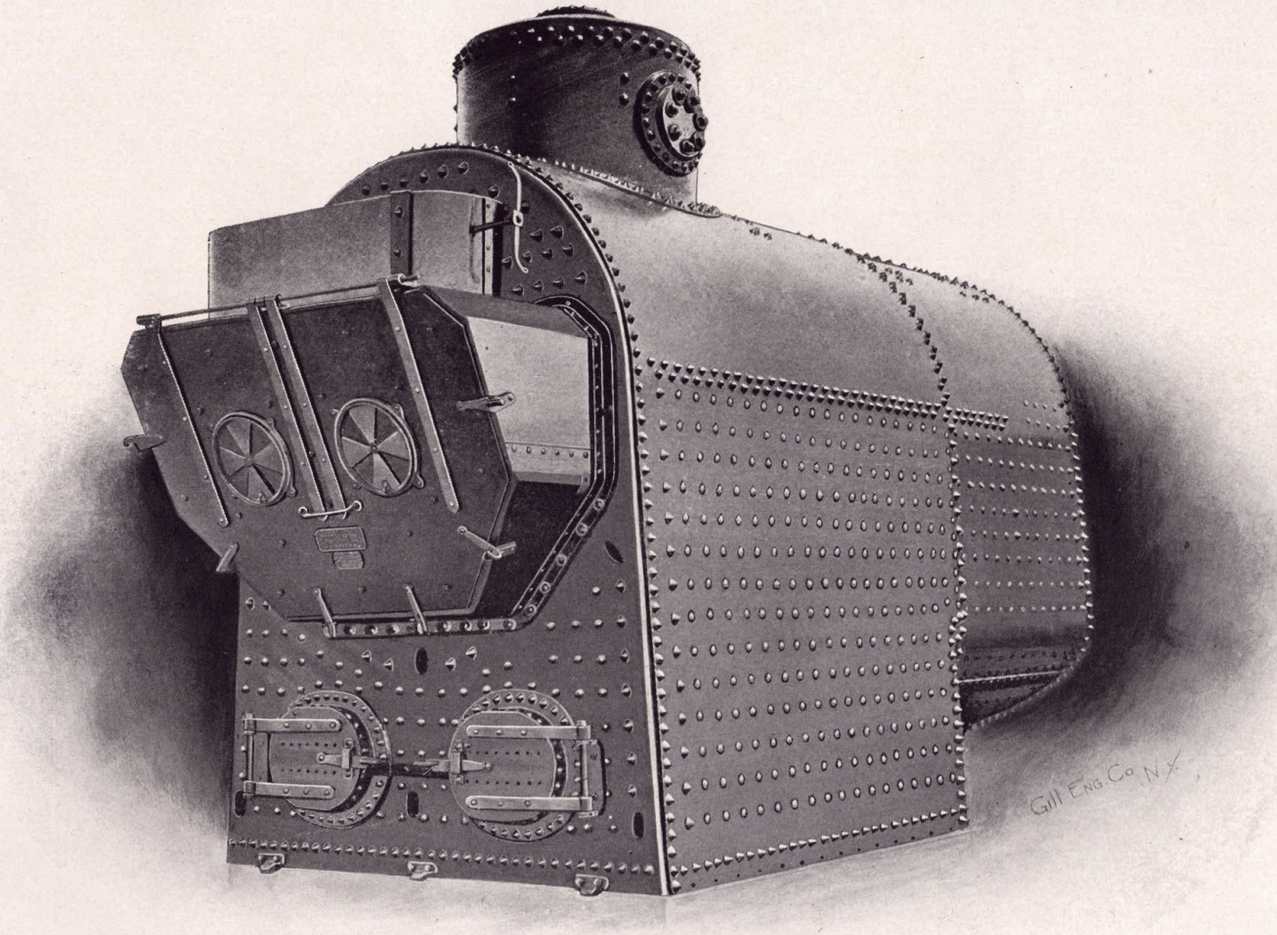
WITH HORIZONTAL SUBMERGED TUBES

VERTICAL MARINE TYPE

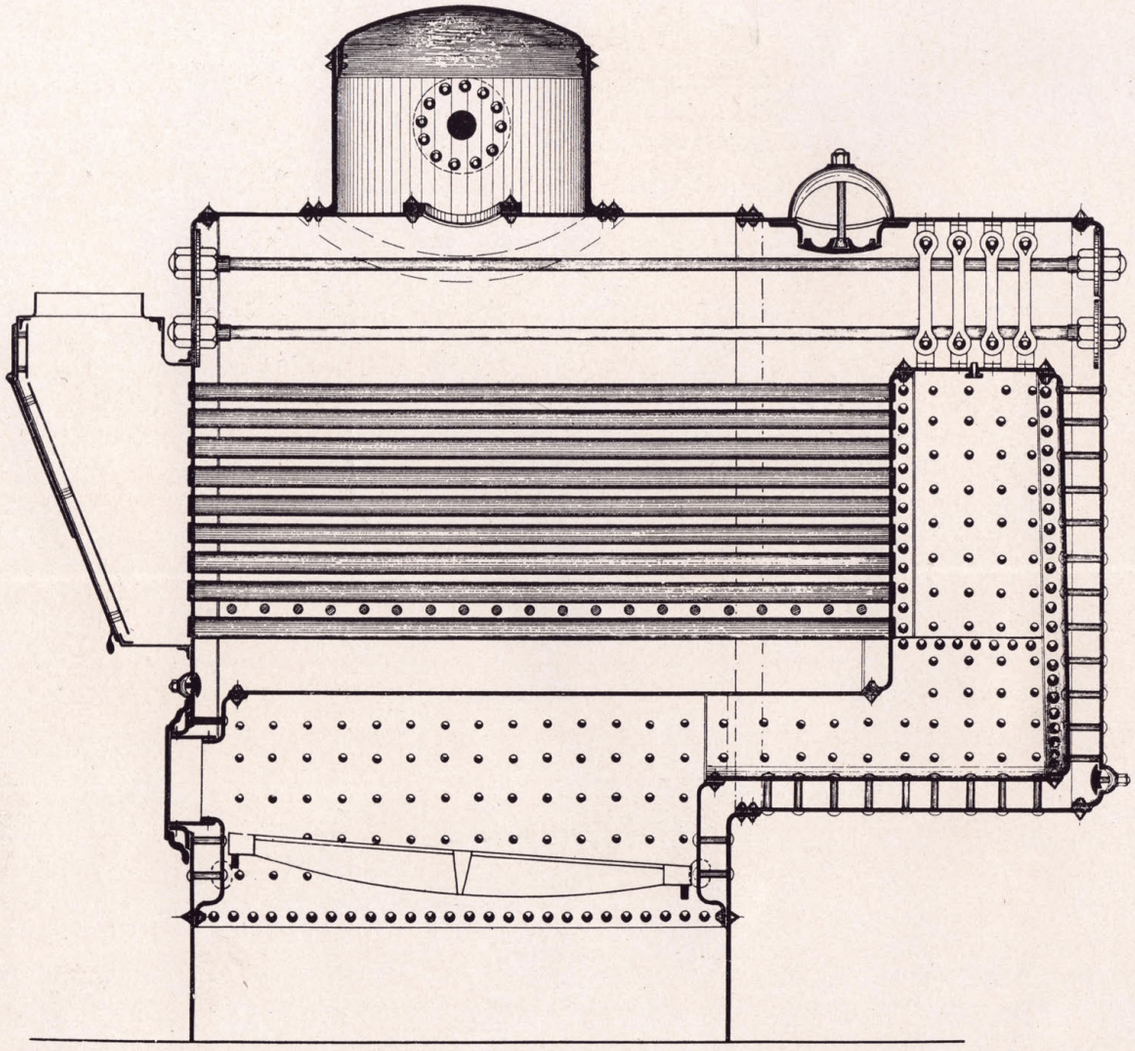
TABLE OF DIMENSIONS, WATER LINES AND CAPACITIES

Number of Size	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.
A	8 6	8 7	8 9	9 0	9 6	10 5	10 10	11 5	11 5	11 7	12 1	12 10	13 7	14 1	14 1	14 1
B Height of Boiler for Steam*	7 0	7 1	7 3	7 6	8 0	8 5	8 10	9 5	9 5	9 7	10 1	10 10*	11 7*	12 1*	12 1*	12 1*
B Height of Boiler for Hot Water*	6 10	6 11	7 2	7 5	7 11	8 3	8 8	9 1	9 1	9 4	9 11	10 8*	11 5*	11 11*	11 11*	11 11*
C Water Line*	6 1	6 4	6 4	6 6	7 1	7 5	7 8	8 2	8 2	8 4	8 10	9 6*	10 1*	10 7*	10 7*	10 9*
D	2 5	2 3	2 5	2 6	2 5	3 0	3 2	3 3	3 3	3 4	3 3	3 4	3 6	3 7	3 7	3 7
E	1 6	1 6	1 6	1 6	1 6	2 0	2 0	2 0	2 0	2 0	2 0	2 0	2 0	2 0	2 0	2 0
F	6 4	7 0	7 10	8 9	9 6	9 7	10 6	10 9	11 8	12 4	13 1	13 7	14 4	14 9	16 0	16 6
G	3 2	3 4	3 6	3 11	4 3	4 8	4 11	5 1	5 3	5 5	5 9	6 3	6 7	6 11	7 1	7 3
H*	2 9	2 10	2 10	2 10	2 10	2 10	2 10	3 1	3 1	3 1	3 3	3 7	3 11	4 0	4 0	4 1
I	2 8	2 10	2 10	3 1	3 8	4 0	4 2	4 6	4 6	4 8	5 0	5 4	5 9	5 11	6 0	6 2
Space to Swing Smoke Doors	3 2	3 2	3 2	2 6	2 6	2 6	3 0	3 0	3 0	3 0	3 0	3 2	3 4	3 6	4 0	4 0
Depth of Smoke Box	14	14	14	16	16	16	16	16	18	18	19	20	20	22	22	24
Length of Tubes	3 8	4 0	4 8	5 7	6 1	6 2	7 1	7 3	8 0	8 6	9 3	9 3	10 0	10 0	11 3	11 8
Steam Openings, number and size	1 5	1 5	1 5	1 6	1 6	1 7	1 7	2 5	2 5	2 5	2 6	2 6	2 6	2 6	2 6	2 6
Direct Radiation, square feet steam	1600	2000	2400	3200	4000	4800	5600	6400	7200	8000	10000	12000	14000	16000	18000	20000
Direct Radiation, square feet hot water	2400	3000	3600	4800	6000	7200	8400	9600	10800	12000	15000	18000	21000	24000	27000	30000
Chimney Area, square inches	314	314	380	380	450	450	530	530	530	575	660	810	910	1020	1075	1150
Chimney Height, feet	50	55	65	65	70	80	80	80	85	90	100	100	110	120	135	150
Smoke Stack Diameter, inches	20	20	22	22	22	24	24	26	26	27	29	32	34	36	37	38

*Heights of Boilers and Water Lines marked with an asterisk include the necessary circular brick base and ash-pit upon which Boilers Nos. 31 and above are designed to stand.
Radiation in the above table includes radiators, risers, supply mains, and all other exposed radiating surfaces.



FITZGIBBONS HIGH-PRESSURE HORIZONTAL MARINE BOILER

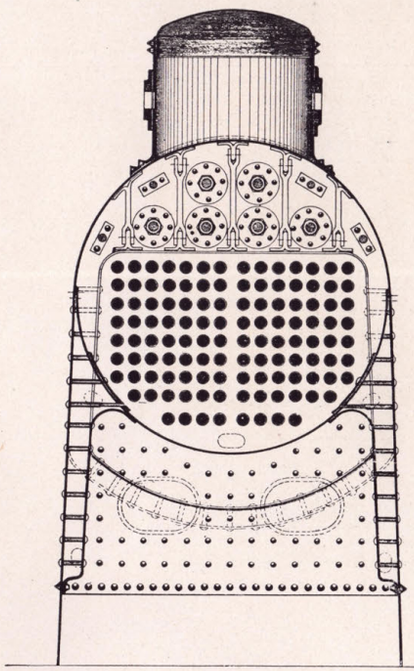


SECTIONAL VIEW OF FITZGIBBONS HIGH-PRESSURE HORIZONTAL MARINE BOILER

FITZGIBBONS HORIZONTAL MARINE BOILER

This boiler is a great improvement over the ordinary marine fire tubular leg type of boiler. It is composed of a cylindrical shell with an independent fire-box below it, utilizing the bottom of this self-sustaining shell for the crown-sheet of the fire-box, thereby eliminating the objectionable inaccessible flat crown-sheet and multiplicity of crow-feet and stays.

The gases from the fire-box are conducted underneath the cylindrical shell through the throat-passage in the boiler into the back combustion chamber instead of by flues through the shell, as is ordinarily done. The throat-passage for the gases is enclosed on the sides and bottom by plates screw-stayed into the outer sheets which form the exterior of the boiler, forming water-spaces between the two. This arrangement not only avoids the use of flues, with their well-known tendency to leak and collapse, but it leaves the entire cylindrical shell for the return tubes, and not only largely increases the heating surface but permits the top row of tubes and the water-level to be kept low (in some cases to the center-line of the shell), reducing the amount of water to be carried in the boiler and largely increasing the steam space. The throat-passage from the furnace into the back combustion chamber is large enough to permit a man to pass through it, and it does away with the necessity for a manhole or door in the rear of the boiler to permit of setting tubes or to make repairs.



SECTIONAL VIEW

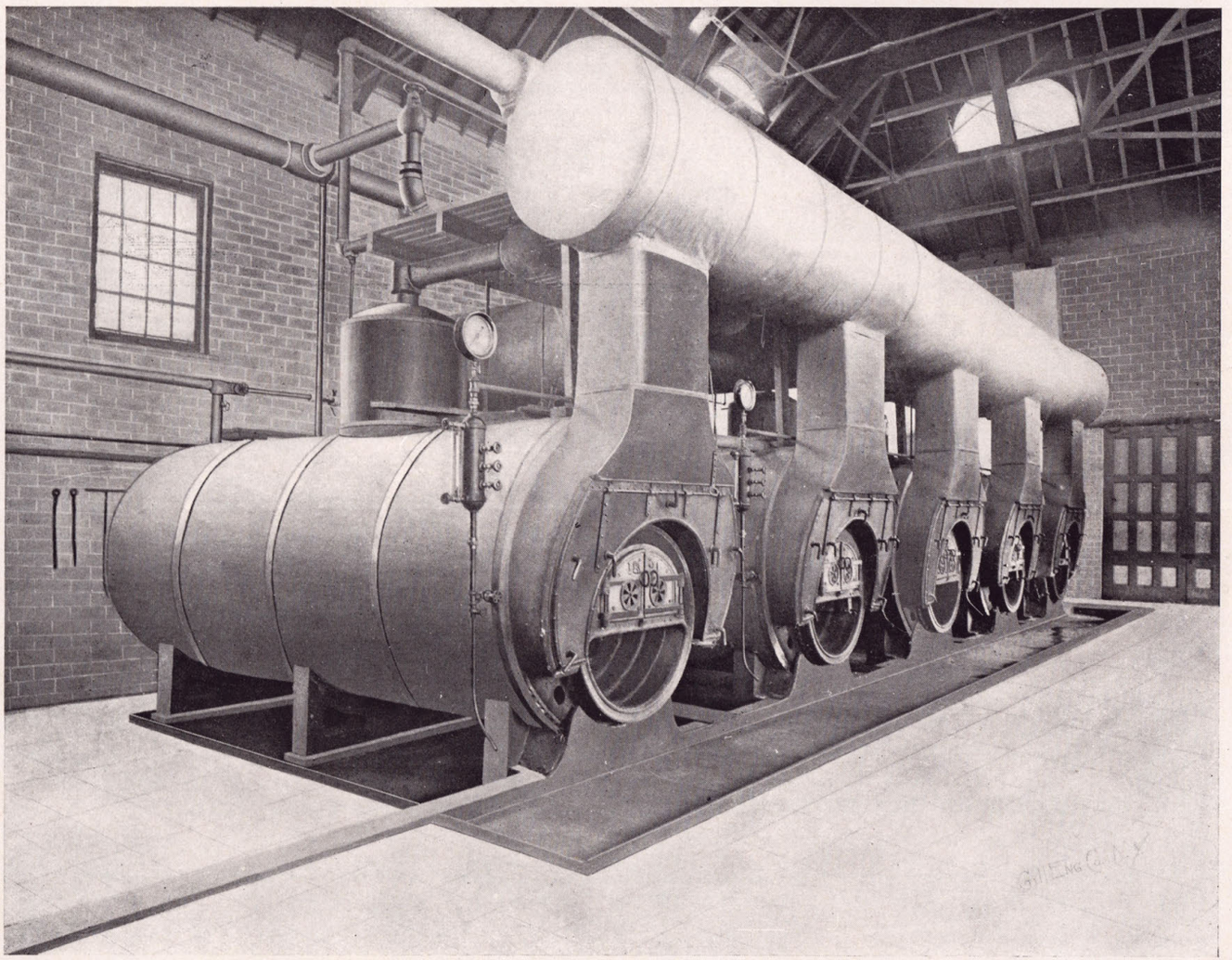
The circulation of water through the water-spaces and the cylindrical shell is free and rapid, which, with the large heating surface in the boiler, gives both exceptionally quick-steaming properties and marked economy in fuel. In addition to the increased heating surface, *which is upward of 30 per cent greater than in any other marine fire tubular type*, the space occupied is also relatively less in proportion to the rated horse power. If it is desirable to obtain more grate surface, the side sheets may be spread outwards in preference to lengthening the grate-bars.

In the design of these boilers the following proportions are approximately observed:

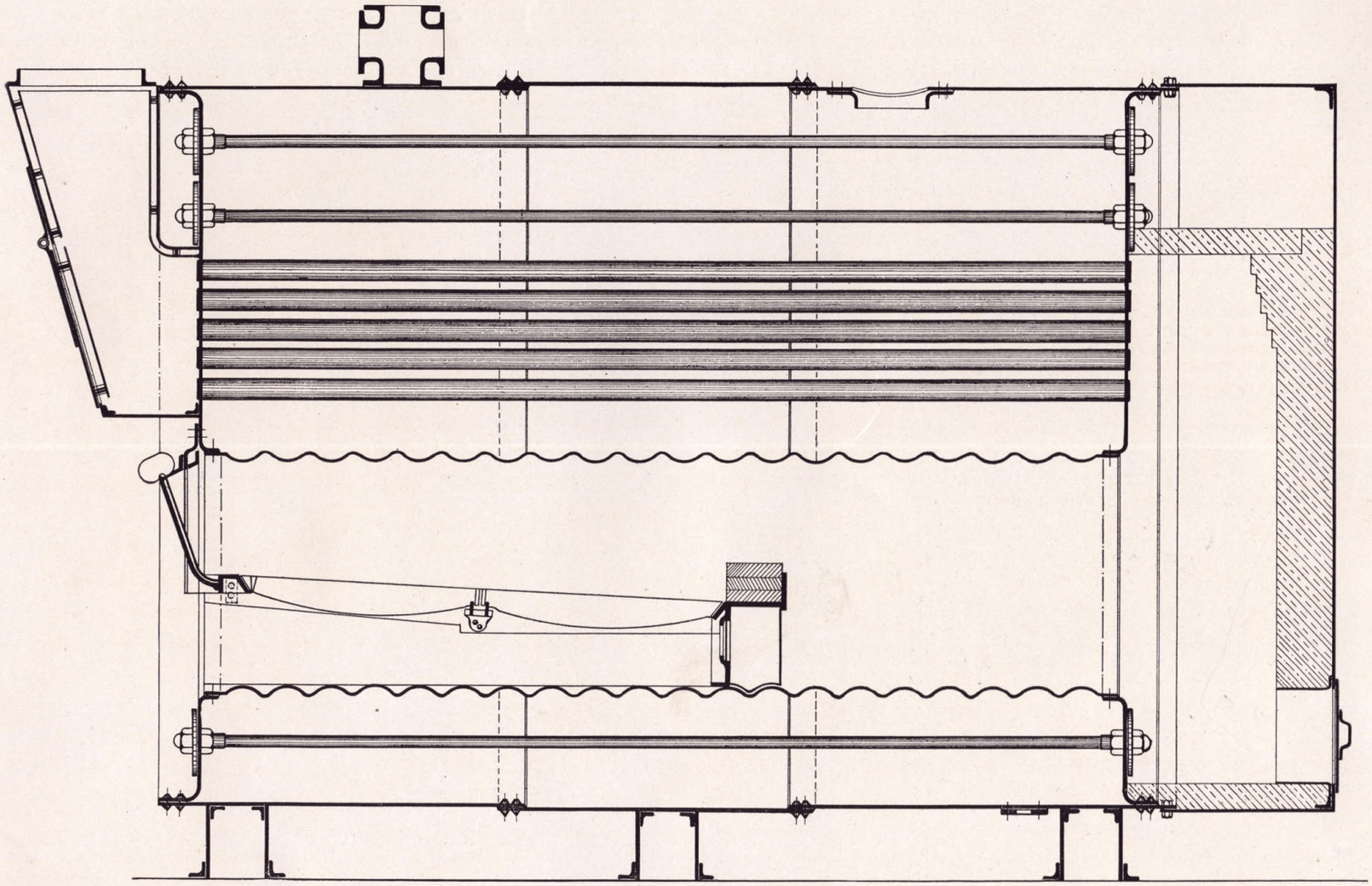
Ratio of grate surface to heating surface, . . .	from 1 to 30 to 1 to 34
" " " " " area of tubes, . . .	" 1 to 8
" " " " " " through throat, . . .	" 1 to 7

Length of tubes in feet about four times the outside diameter of the tubes in inches.

This type of boiler has been adopted by the Canadian Government for marine purposes, and both on the Coast and Great Lakes they have displaced other popular marine types, in each instance, without exception, not only developing greater efficiency but demonstrating the greatest advantage in durability and economy of maintenance.



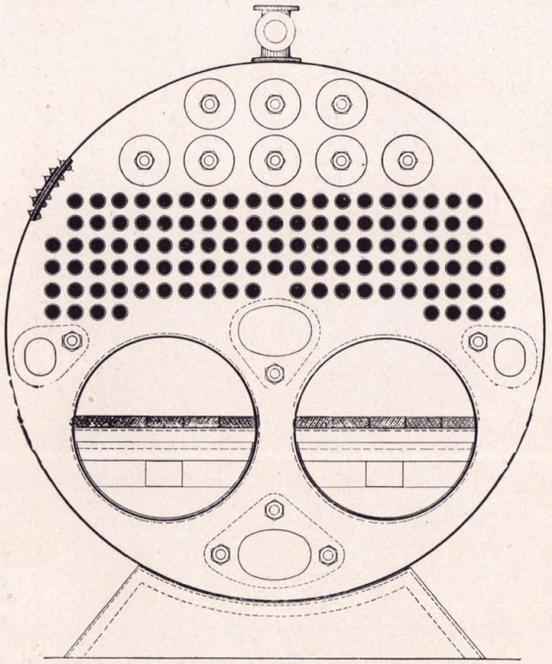
A STATIONARY POWER PLANT OF SCOTCH MARINE BOILERS



SECTIONAL VIEW OF SCOTCH MARINE BOILER WITH A MORISON SUSPENSION FURNACE

STANDARD SCOTCH MARINE TYPE OF BOILER

The illustrations on pages 27 and 28 represent the well-known Scotch Marine type of boiler in general use in all countries for marine work requiring high pressure of steam, on account of its simplicity and self-sustaining strength. The boiler is efficient in comparison with externally fired boilers, but in boilers of large size should be constructed with two or more furnaces, so as to avoid a large body of dead water. They are built with the Adamson joint, but preferably with the Morison or Fox corrugated furnaces. Especially for high steam pressures the use of the corrugated furnaces above mentioned is recommended, as they are capable of a wider range of expansion and contraction, and from the nature of their construction offer a very material and effective increase in the heating surface in the boiler. These boilers are constructed with either a water or brick-lined back connection, the latter, on account of the saving in cost, being usually employed in boilers designed for stationary plants. Moreover, the argument in its favor and advanced by many of its users, is that the brick lining attains such a degree of heat in the back combustion chamber that the unconsumed gases are there ignited. These boilers are accessible in every part for thorough cleaning as will be seen in the sectional cuts. Every detail in their construction conforms with the best rules known to modern practice. The furnaces are fitted with the well-known Morison frames and doors. The uptake is made of shell steel, bound with angle irons and securely fastened to the front head. The bridge walls are cast in two pieces so as to allow for free expansion, and are fitted with doors below the grates for cleaning out the ashes. Owing to the large steam space in this type of boiler, a perforated dry pipe is used instead of a steam dome, which admits of a boiler of larger diameter being installed where the head room is limited. A pressed steel manhole plate and yoke are used exclusively, and the opening in the shell is reinforced with a heavy wrought-iron ring. The heads are braced in the most thorough manner as shown in cut, the fore and aft braces being spaced so as not to be subject to a greater strain than 6,000 pounds to the square inch of section. The combustion and the circulation in this type of boiler will not equal these conditions in the Fitzgibbons Vertical Marine type, but on account of its cylindrical form it is better adapted for marine uses.



SECTIONAL VIEW

STANDARD SCOTCH MARINE BOILERS

WITH MORISON SUSPENSION FURNACES, FOR STATIONARY STEAM PLANTS

Rated Horse-Power	Grate Surface in Square Feet	Heating Surface in Square Feet	Ratio H. S. to G. S.	Diameter of Tubes	Number of Tubes	Area Through Tubes, Square Feet	Ratio Area Through Tubes to G. S.	Diameter of Boiler Shell		Inside Diameter Corrugated Furnace	Length of Grate		Depth of Combustion Chamber	
				In.				Ft.	In.	In.	Ft.	In.	Ft.	In.
75	15	527	35.2 to 1	3½	42	2.44	1 to 6.15	6	6	36	5	0	2	0
100	20	733	36.6 to 1	3½	56	3.25	1 to 6.15	7	0	38	6	4	2	0
125	25	905	36.2 to 1	3½	70	4.06	1 to 6.15	7	6	45	6	8	2	0
150	30	1071	35.7 to 1	3½	80	4.64	1 to 6.46	8	0	50	7	3	2	0
200	40	1423	35.6 to 1	3½	108	6.26	1 to 6.39	9	6	38	6	4	2	0
250	50	1780	35.6 to 1	3½	137	7.95	1 to 6.40	10	6	45	6	8	2	0

SPECIFICATIONS

FURNACE—The furnace to be of the Morison suspension type, having plain parts at the front and rear ends of sufficient length to be single riveted to the furnace opening flanges of the boiler-head.

BACK CONNECTION—The rear course of the boiler shell is to extend about 2½ inches beyond the flange of the rear head, and to it is to be bolted an extension forming a back connection. This extension is to be of sufficient width to provide for a combustion chamber having a clear depth of 24 inches. Riveted to the inside of this extension at its outer end is to be a ring of 2½ x 2½ x 5-16 angle iron, to which will be bolted a head of steel made in two pieces joined together by bolts. In the lower portion of this head there is to be an opening surrounded by an angle-iron ring, forming a stiffening angle bar. The inside circumference of the combustion chamber is to be lined with fire-brick placed on edge, forming a lining 4½ inches thick. This lining is to extend circumferentially upward to a point one inch above the highest row of tubes. The back of the combustion chamber is to be lined with fire-brick to a thickness of 9 inches. This lining on the back-head is to be carried to the same height as the circumferential lining, and the opening at the top to be bridged over with fire-brick tiles 5 inches in thickness, one end of the bricks resting on an angle iron riveted to the back-head of the boiler.

RIVETS AND BRACING — The rivet-holes to be drilled or punched 1-16 inch small and then reamed to proper diameter. No drift-pin is to be used. The boiler-heads are to be braced as shown in sectional cut, with suitable nuts and washers both inside and out where the brace is secured up to the heads.

MAN AND HANDHOLE OPENINGS — An Eclipse manhole and cover, 11 x 15 inches, provided with suitable yokes and bolts, is to be fitted on the top of the shell. In the front head, below the tubes, man and handhole openings are to be located as shown in cut on page 29, and fitted with suitable plates, bolts and crabs. The openings in the shell and heads are to be reinforced by strengthening pieces of equal thickness to the plate to which they are to be securely riveted.

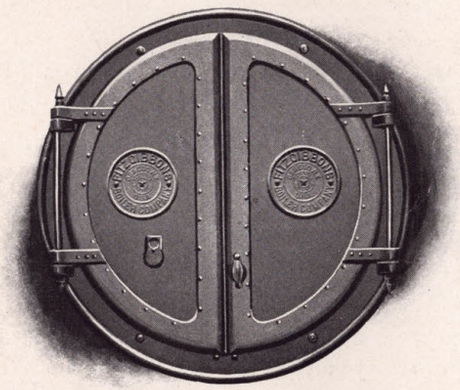
SMOKE BREECHING — The smoke breeching to be made of steel plate secured to the front head of the boiler by 2½ x 2¼ angles and studbolts and to have an interior lining of plate, with an inch air-space formed by thimbles. On its upper portion it will have a suitable opening for the smokestack, bound with heavy angle iron. The front of the smoke breeching is to be provided with a door fitted with proper hinges and latches and two butterfly dampers. The door is to be provided with a lining affording an inch air-space.

FURNACE DOORS — The front of the furnace is to be closed with a Morison protector furnace front and doors, and below it is to be fitted with heavy sheet-iron ash-pit door with proper handles for holding it in position.

BRIDGE WALL — There is to be a cast-iron bridge wall, topped with fire-brick, placed in the furnace. Midway between it and the dead-plate of the furnace front is to be located a double-bearer bar, the ends of which are to rest upon clips securely fastened to the furnace. The grates are to be of cast-iron, provided with suitable openings. Beneath the grate is to be an ash-pan bent to shape and extending from the bridge to the front of the furnace.

SADDLES — The boiler is to rest on cast-iron or plate-steel saddles conforming to the shell.

FITTINGS — Upon the top of the shell and about the middle of the first course, is to be located a nozzle so arranged as to provide on its upper side a flange for a safety-valve and on its side or sides flanged openings for steam connections. Extending into the boiler from this nozzle, there will be a short pipe nipple, fitted to a tee, from the branches of which will extend a dry-pipe, each branch of which will be about three feet long, perforated with openings along its upper surface, giving an aggregate area of about two and one-half times the area of the steam pipe. Upon the side of the boiler a feed opening will be located, properly reinforced with a heavy flange. A nipple is to be screwed in this opening and connected with a pipe extending approximately one-half the length of the boiler, having perforations along its lower surface with an aggregate area of twice the area of the pipe. The internal pipe will be located about the height of the top row of tubes and parallel to them. In the bottom of the shell a suitable opening, reinforced with a heavy flange, will be provided for a bottom blow-off.



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